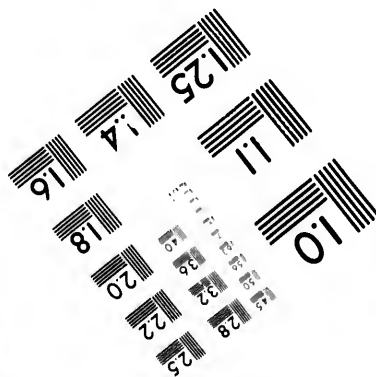
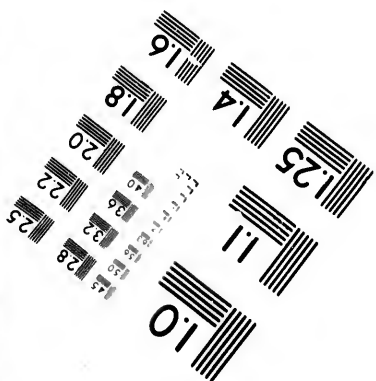
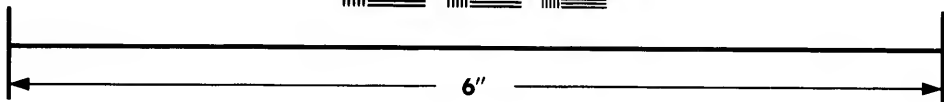
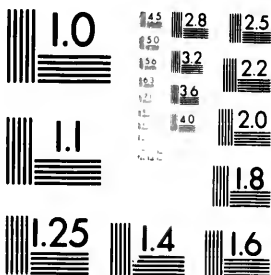


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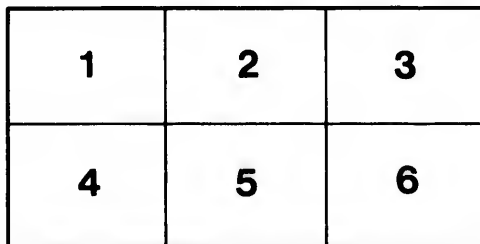
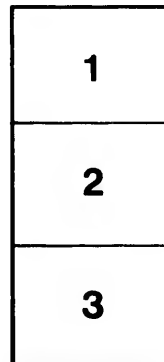
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**GEOLOGICAL AND NATURAL HISTORY SURVEY OF CANADA**  
**ALFRED R. C. SELWYN, LL.D., F.R.S., DIRECTOR.**

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**REPORT**  
**OF**  
**EXPLORATIONS AND SURVEYS**  
**IN PORTIONS OF**  
**YORK AND CARLETON COUNTIES,**  
**NEW BRUNSWICK.**

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**1884.**

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By **L. W. BAILEY, M.A., Ph.D., F.R.S.C.,**  
PROFESSOR OF NATURAL HISTORY IN THE UNIVERSITY OF NEW BRUNSWICK.



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**1884.**

To ALFR

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TO ALFRED R. C. SELWYN, Esq., LL.D., F.R.S.,

*Director of the Geological Survey of Canada.*

SIR ;—I beg to submit herewith a report of geological investigations in central New Brunswick, made by myself and others up to the close of the past season.

Accompanying the report is a map embodying the results of those investigations and constituting quarter sheet No. 1 N. W. of the geological map of New Brunswick now in process of construction. Large portions of the area represented, more particularly in Queen's and Sunbury counties, have been fully described in previous reports. The present report relates to those portions of York and Carleton counties to which the investigations of the years 1831-83 have been confined.

In addition to the aid afforded by my successive assistants, Mr. Wallace Broad in 1879 and Mr. Wm. McInnes in 1883, by whom the greater part of the topographical work and map-making has been effected, I would here express my obligations to members of the staff in the Crown Lands Department in Fredericton for the use of their office in draughting as well as for copies of plans and surveys, and to the Manager of the New Brunswick Railway Company for free passes over the lines of that company granted to myself and assistants.

In addition to the work on the rock formations, the investigations in New Brunswick during the past season included a study of its superficial geology by Mr. R. Chalmers. The results of these investigations form the subject of a separate report.

I have the honour to be,

Sir,

Your obedient servant,

L. W. BAILEY.

FREDERICTON, N. B., March 25th, 1884.



POE

The region described as a portion of C equal section and the other more remains report on the in the present less extensive T. Jackson Prof. C. H. tion with the R. W. Ellis. the Reports made by me lying to the tial examination in the country 1881 and 18 both sides of these latter requested the sary data for follow are and supplies

REPORT  
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EXPLORATIONS AND SURVEYS  
IN  
PORTIONS OF YORK AND CARLETON COUNTIES,  
NEW BRUNSWICK.

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The region to which this report more particularly relates may be described as embracing the northern half of York and the southern portion of Carleton county; being divided obliquely into two nearly equal sections by the valley of the St. John River, from which one section extends in a westerly direction to the United States boundary and the other eastwardly to the valley of the Nashwaak River. The more remarkable physical features of the region are described in the report on the surface geology by Mr. Chalmers, and are further noticed in the present report. Its geology has been the subject of more or less extensive examination by various observers, including Dr. Chas. T. Jackson (1837), Dr. A. Gesner (1842), Prof. James Robb (1849), Prof. C. H. Hitchcock (1862), Prof. H. Y. Hind (1865), and in connection with the Dominion Geological Survey by Mr. Chas. Robb and Mr. R. W. Ells. The reports of the last two gentlemen are contained in the Reports of Progress 1866-69 and 1874-75. In 1879 a survey was made by myself and Mr. Wallace Broad of that portion of the country lying to the westward of the St. John River, and simultaneously a partial examination of the district along the eastern side of the same river, in the county of Carleton, was made by Mr. G. F. Matthew. In 1880, 1881 and 1882 the survey and work of exploration was continued on both sides of the river by Mr. Broad. No report, however, on any of these latter investigations had been made when, in 1883, I was requested to resume the direction of the work and to obtain the necessary data for the completion of the map. The observations which follow are the results of the past season's work, as both comprehending and supplementary to those which have preceded it. In the prepara-

Region described.

Earlier investigation.

tion of the map the larger part of the topographical data was obtained and the subsequent reductions effected by Mr. Broad and his successive assistants, to one of whom, Mr. W. McInnes, my own assistant during the past summer, the final completion of the work is due. For the geological boundaries and determinations, as well as for the views of structure or origin hereinafter expressed, I am alone responsible.

### G. CARBONIFEROUS.

A considerable portion of the area included in the map to which this report relates is occupied by rocks of Carboniferous age, but as these have been for the most part described in previous reports, it will not be necessary to dwell at length upon them here. As in other parts of the province they present two marked subdivisions. These are strongly contrasted, alike in color, composition and agricultural capacity. There are also many evidences of their unconformability.

**Upper Division.** It covers extensive areas in York and Sunbury counties, and is readily recognizable by its generally grey color and coarse texture. The latter feature increases towards the base of the formation, where the beds are usually a very coarse conglomerate, largely consisting of white quartz pebbles. Beds of massive sandstone, of grey and purple colours, are often found higher in the series. These are admirably adapted for architectural purposes. Thin seams of coal are not uncommon, but no beds of workable thickness are known to occur. The country occupied by these rocks is flat and undulating. To the southward, in the direction of the centre of the Carboniferous basin, it becomes low, but in the opposite direction is more hilly, and along its northern edge often presents long and high mural escarpments. In general its agricultural capabilities, owing to the sandy character of the soil, or where clayey, to imperfect drainage, are of low grade, but where the grey are replaced by red or purplish red beds, there is usually a considerable improvement in this respect, while the occurrence of numerous streams and rivers gives rise to extensive intervals, on some of which are the most productive soils in the province.

**Lower Division.** In contrast with the coal measures, wherever the Lower Carboniferous rocks occur, there are soils of great fertility. This is evidently the result of the highly calcareous nature of the beds and the consequent facility with which the latter crumble and disintegrate. Their color is very generally red, varying from a deep brick red on the one hand to a brownish red or chocolate brown on the other; and in texture they range from coarse conglomerates to fine marls and shales. At several points, (more particularly referred to in the sequel), they include small beds of limestone.

At the surface of the Millstone grit semi-volcanic clays and shales reports. The other or soft to their as color of the

In general not far from a limited plain John River 90°. The angles, but connected with

The surface and coal measures and by the marks of evidence of nature together with show clearly over the frequent cate that the position of the Lower Carboniferous the Silurian

The rocks of Carleton County the northern formation, their contactors. Mention of the Silurian rocks to the group the main definitely. eastern Carleton in the occurrence

At the summit of the Lower Carboniferous and directly beneath the Millstone grit there are found at several points beds of volcanic or semi-volcanic origin, such as basalt or anamesite, amygdaloid, felsite, claystone porphyry, &c., the details of which are given in earlier reports. Their position is thus the same as that of similar beds on the other or southern side of the great central Carboniferous basin. It is to their association with beds of this character that the bright red color of the accompanying sandstone and shales is due.

In general the attitude of the coal measures and millstone grit is not far from horizontal. A remarkable exception, however, occurs in a limited patch of such rocks to be found on the eastern side of the St. John River, in the parish of Bright, where they have a dip of nearly 90°. The Lower Carboniferous beds are also often inclined at low angles, but with more numerous exceptions, these being apparently connected with the greater inequality of the surface on which they rest.

The supposed unconformability between the Lower Carboniferous and coal measures is evidenced not only by local differences of attitude and by the occurrence of volcanic outbursts between the two, but by the marks of extensive erosion along their surfaces of contact. The occurrence of numerous small detached areas of both these formations, together with their attitude with regard to the surrounding region, show clearly that they both at one time spread widely if not continuously over it, but the irregularity of their distribution, together with the frequent absence of the lower beds altogether, would seem to indicate that these had been already extensively removed prior to the deposition of the later strata. It is noticeable that in Carleton county the Lower Carboniferous belt follows approximately the line of contact of the Silurian and Cambro-Silurian systems.

#### E. SILURIAN.

The reference of Pre-Carboniferous rocks in the northern portion of Carleton County, in common with those occupying the larger part of the northern portion of the Province, to the so-called Upper Silurian formation, was first made by Dr. Gesner in 1842, on the evidence of their contained fossils, and has been generally accepted by later investigators. Much uncertainty has, however, existed as to the exact position of the boundary between the Silurian and the supposed Cambro-Silurian rocks which border them on the south, as well as with regard to the grounds of their separation; and it has accordingly been one of the main objects of recent exploration to settle these points more definitely. In the summer of 1879, Mr. G. F. Matthew, in his study of eastern Carleton, found evidence of the looked for physical break in the occurrence, along the course of the tributaries of the Beccaugui-

mic River, of conglomerates near the base of the Silurian system containing embedded fragments which were clearly traceable to the Cambro-Silurian rocks below; while in the same season the author of the present report was led to recognize a similar line of separation in the region west of the St. John River. The observations of Mr. Matthew derived additional importance from the fact that the rocks along the supposed line of junction were at several points found to hold organic remains which, it was hoped, would be the means of fixing definitely the age of the beds in which they are contained.

Between the two regions, however, there existed a considerable interval, and it was hence thought desirable in connection with the work of the past season that the formations thus independently studied should be traced into connection, and that by the collection of additional fossils from the Beccaguimic, such aid should be obtained towards the elucidation of the age and structure of the district as these might be able to afford. This was accordingly done, and a careful re-examination made of the whole area. Unfortunately, however, the fossils obtained, though they embrace a considerable variety of forms, such as brachiopods, crinoids, trilobites, orthocerata and graptolites, and in some instances are pretty well preserved, are mostly fragmentary and have proved too imperfect for even generic determination. For this reason and from the fact that the district in which they occur will be the subject of renewed and more extended examination in another season, it has been thought best not to consider them further here, but to confine the present report to the region embraced in the map which accompanies it. For a like reason the following observations on the Silurian district are for the most part restricted to what is seen along its southern margin.

Fossils.

Succession on  
St. John river.

The highest Silurian beds to which reference will here be made occur along the west bank of the St. John River, at and below Hartland Ferry. They are soft clay slates which are conspicuously banded with thin alternating layers of calcareous and argillo-calcareous material, and with which thin beds of quartzite also occur. The calcareous layers are from one to four inches in thickness, and attempts have been made to burn the rock for lime, but without success. Their dip is mostly to the northwest but irregular, and with several reversals. In descending on the measures they are found to include several heavy beds of grit and conglomerate. These are largely composed of pebbles of grey quartzite and black petrosilex closely resembling in character portions of the rocks to be presently described as Cambro-Silurian, and indicate an approach at this point to the base of the Silurian system. The superposition, however, at Victoria Corners, of a belt of Lower

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Carboniferous rocks prevents the actual junction of the two systems from being observed.

From Victoria Corners to the iron-works near Woodstock, the same Lower Carboniferous belt hides from view the subjacent rocks, but beyond this point they again appear and their line of junction can be readily traced to the western frontier of the province. Crossing the Meduxnakeag River and the Houlton road, about a mile and a half west of Woodstock, it follows a nearly uniform southwesterly course. It intersects the New Brunswick railway (Woodstock Branch) between the 84th and 85th mile-posts, or about two miles east of Debec Junction, and again at O'Donnell's crossing, south of the latter. Thence it extend along the Pokomoonshine Brook to Kirkland post office, in South Richmond, and finally crosses Bull's Creek, a tributary of Eel River, and the northern boundary of York county, in Monument settlement. Through this district the conglomerates which mark the base of the Silurian system are exposed but at few points. They may, however, be seen near O'Donnell's crossing, where they repose unconformably upon a pale quartz-porphry, from which their included pebbles have been in part derived; and again on Bull Creek where they are similarly filled with fragments derived from the underlying rocks. It is further noticeable that in approaching the frontier to the southwest, these basal beds of the Silurian successively overlap different members of the Cambro-Silurian system and hide them from view. Thus the unconformity of the two systems is strongly marked, as these are also in strong contrast in their lithological characters and in the conditions of their origin.

Contact of formations.

Woodstock.

Richmond.

Unconformity and overlap.

Limestone.

The banded grey and dark grey calcareous slates which succeed the basal conglomerates last noticed, are readily traceable through southwestern Carleton, having a nearly uniform southwesterly trend and a general dip to the northwest, though with many local irregularities. They contain also, as on the St. John River and in the Beccaguimic region, occasional beds of limestone. One of these, at Joy's Corner, near Lake Asphaltes, was formerly worked for lime, but owing to its unfavorable position has been abandoned. It abounds with crinoid stems and small brachiopods, showing chiefly on weathered surfaces, but which are too imperfect for identification. Buff weathering sandstones resembling certain beds which on the Beccaguimic are highly fossiliferous, also occur, but were not found to contain any organic remains. Farther north, and forming a portion of the same system, are the red hematite slates of Jacksontown. These are mostly, however, beyond the limits of the map, and as they have been fully described in earlier reports, will not be further noticed here.

Fossils.

Hematite.

## D. CAMBRO-SILURIAN.

The rocks now to be described as Cambro-Silurian are a part of those which in earlier reports have been variously described as Cambrian (Gesner and J. Robb), Mica-schist formation (Hitchcock), Quebec group (Logan and Hind), Lower Silurian (Bailey and Ells), or simply as non-calcareous slates, gneisses, etc., (Chas. Robb). They lie on either side of, or as outliers on, the great central granite axis of York county, and with the latter extend to the northeast, where they are believed to be continuous with the similar beds described and mapped by Mr. Ells in the counties of Northumberland and Gloucester. It is but right, however, to state that in referring them to the horizon first above named, this is done in the absence of any positive proof of their true position. Within the region examined they have as yet yielded no fossils, and the only evidence of age is that furnished by the unconformable overlap of the Silurian rocks, as described in previous pages, and the fact that they have supplied material for the formation of the conglomerates at its base. They are thus at least as old as the Cambro-Silurian, to which they are here provisionally referred. Amid strata, however, of such diverse character, which include at many points rocks of igneous or semi-igneous origin, which are not only in contact with, but are penetrated by great masses of intrusive granite, and which are themselves, over large areas, of a highly crystalline character, the writer would hesitate to assert that there may not also occur rocks of Cambrian or even of Pre-Cambrian age. On the contrary, among the descriptions which follow, references will in several instances be made to cases in which irregular masses of fine grained rock, which are more or less crystalline and of obscure stratification, are associated with the usually schistose strata of the region in such a way as to indicate that they may possibly be protruding Pre-Cambrian bosses. As these, however, invariably partake more or less of an igneous character, it is always a question and one usually not easily answered, whether they are not rather to be regarded simply as eruptive masses, contemporaneous with or even later in origin than the beds which they accompany. The facts that in several instances they exhibit, through long distances, a close parallelism with the general trend of the latter, that in some cases the sedimentary and volcanic sediments are interbedded, and that the former are of such a character as are usually found accompanying rocks of igneous derivation, have led the writer to regard them, at least provisionally, as members of one system. It may be added that in all these features they not only resemble the formations described by Mr. Ells towards the Baie Chaleur, but those also which border the northern edge of the granite in Charlotte county, and which have been similarly mapped as Cambro-Silurian.

Earlier investigations.

Supposed age.

Pro-Cambrian rocks.

Igneous rocks.

BAILEY.]

It will crystalline brought and region and its position of the fact warrant.

The distance of various overlapping Silurian, character lines of the second between the miles; the side of the to a north of the Silurian west side of Canterbury of the larger part of Brighton is continuous of the Newport upon east coast.

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It will be evident that in the discussion of this system of highly crystalline rocks and their relations to the granite, one is necessarily brought face to face with all the vexed and difficult questions of local and regional metamorphism, including the origin of the granite itself and its possible influence. Without entering at length into the discussion of these questions, it is proposed to give here simply a summary of the facts observed, with such conclusions as they may seem to fairly warrant.

Questions of metamorphism.

The district occupied by the northern belt of Cambro-Silurian strata is of variable breadth and irregular outlines, due on the one hand to the overlapping of Carboniferous strata along its line of junction with the Silurian, and on the other to the sinuous, ill-defined and often vein-like character of the granitic axis which bounds it on the south. Of these lines of contact the first has been already described, and details of the second are given in the sequel. It will be enough to state here that the width of the belt as exhibited along the St. John river, between the mouth of the Sheogomoc and Woodstock, is about fifteen miles; this is slightly increased along the lines of railway on either side of the first named stream, but near the western frontier, owing to a northward bend of the granite in connection with the trend of the Silurian, is reduced to about one quarter of that amount. On the west side of the main river it includes about one half of the parishes of Canterbury and North Lako in York county, and the southern half of the parish of Woodstock, while eastward of the river it occupies the larger part of the parish of Southampton in the first, and much of that of Brighton in the second of the counties named. In this direction it is continuous with a belt of similar rocks extending across the valley of the Nashwaak, the limit of our exploration, but is known to re-appear upon the Miramichi and its tributaries, as well as upon the north-east coast, where it has been examined and described by Mr. Ells.

Northern belt.

Its limits.

The second or southern belt is less extensive and at the same time more variable in contour than the northern, for while one of its borders, corresponding to that of the granite, is tolerably uniform, the other is rendered irregular by the encroachment of the Carboniferous strata which bound it upon the south and mark the northern edge of the great central coal-field of the province. On the west of the St. John this belt occupies the greater portion of the parishes of Prince William and Kingslear and on the eastern side portions of the parishes of Queensbury and Bright. The average breadth is about twenty miles, but along the Keswick valley and the line of the New Brunswick railway this is reduced, by the overlapping of Carboniferous sediments, until it hardly exceeds four or five. In the upper part of the same valley the area occupied by these rocks becomes, through

Southern belt.



- Limits.** the partial disappearance of the granite, continuous with that of the third or central belt of schistose strata, extending through the Caverhill and Haynesville settlements, and with the latter is prolonged in an easterly direction to the Nashwaak River, upon which it includes the entire interval between Stanley Bridge and the mouth of the Napa-daugon.
- Topography.** The several districts above referred to are very generally of a hilly and broken character, exceeding in this respect even the granite areas with which they are associated. This is especially true of the northern belt, which along much of its extent is marked by the occurrence of prominent ridges, such as Pokowogamis Ridge, Oak Mountain, Carrol Ridge, Sheogomoc Ridge and Dorrington Hill on the western, and Maple Ridge, Howland Ridge, &c., on the eastern side of the St. John River, their average elevation being about 600 feet; while in the case of the southern belt a similar feature is seen in such prominences as Magaguadavic, Blaney and Magundy Ridges and the Keswick Ridge. In each district, however, there are large areas which, while far from being low, are comparatively flat, as along either of the lines of railway leading north to Woodstock, and near the western frontier in Monument settlement. As usual the character of the soils and the general agricultural features of the region are primarily dependent upon the nature and durability of the underlying rocks, which by their hardness determine a more stony, and by the comparative absence of lime a much less productive soil than such as characterizes the Silurian region; but their effects are greatly modified, whether favorably or unfavorably, by the distribution of the drift.
- Soils.**
- General geological features.** As already intimated, and as further suggested by its topography, the rocks in the Cambro-Silurian area are highly disturbed as well as greatly altered. The strata are everywhere tilted at high angles, with innumerable folds and contortions, and with repeated indications of faulting. In addition to the main axis of granite, they are invaded by several smaller masses of the same rock, as well as by syenite, felsite, diorite, &c., which help still further to obscure their geological relations. Indeed no finer illustrations of arched and crumpled strata are to be found in the province, and probably not in Acadia, than are afforded by the almost continuous section of these rocks exposed along the St. John River valley, between Woodstock and Fredericton, while along the lines of contact with the granite on the same section equally fine opportunities are afforded for the study of the supposed connection of the latter with the metamorphism of the associated strata. Innumerable veins of granite are seen to penetrate the adjacent schists, while detached blocks of the latter, of every shape and size, may also be seen actually imbedded in the granitic mass. In view of these
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facts, in connection with the further circumstance that the country occupied by the Cambro-Silurian rocks is still only partially cleared and largely covered with drift, it is very difficult, if not impossible, to reach satisfactory conclusions either as to their succession or thickness, but the following ascending arrangement is that which seems best to accord with the facts observed:—

PROBABLE SUCCESSION OF CAMBRO-SILURIAN STRATA.

Coarse to fine grey gneiss and dark-grey mica schist; chloritic, hornblende and felspathic schists, with heavy masses of diorite and felsite.

Grey, dark-grey and purplish-grey (or lilac) micaceous sandstones and slates, with thin beds of limestone and belts of grit and conglomerate; grey felspathic slates and quartzites; intrusive and interbedded diorites.

Supposed  
succession.

Dark-grey to black pyritous and graphitic slates.

Highly felspathic schistose rocks, often gritty with particles of white quartz and angular pieces of felsite, in part a coarse conglomerate.

Grey, green and purple amygdaloid, vesicular sandstone and slate, in heavy beds.

Grey and pale-grey, pink and reddish felsite.

Grey felspathic sandstones or quartzites and slates, often chloritic.

The highly crystalline gneissic and micaceous strata which, from their position, are believed to be the oldest representatives of the Cambro-Silurian system, are most clearly exhibited on the northern side of the granite, in the parish of Canterbury, where they occupy a broadly crescentic area, having its greatest width, of about six miles, along the main line of the New Brunswick railway, and from this narrowing westwardly to the frontier at North Lake, and eastwardly to the St. John River about Sullivan's Creek. Through the length of this area all the more prominent members may be continuously traced.

Gneiss and  
mica schist in  
Canterbury.

Near the granite the rock is usually a fine-grained, imperfect gneiss, of a grey color, commonly very much corrugated and mingled with granitic or quartzose veins in the most complicated manner. At some points, however, as at the head of North Lake, the rock is coarser, and is in part a true granitoid gneiss, of the ordinary composition, weathering with a rough uneven surface, while other portions are composed of a granular admixture of felspar, mica, hornblende and chlorite, with but little quartz. With the gneisses occur well developed mica-schists, which are highly cleavable and lustrous. They also contain numerous veins of quartz, and occasionally hold minute garnets or imperfectly developed crystals of staurolite. The rock most commonly met with, however, throughout the district, and sometimes in close proximity to

North Lake.

Micaceous  
sandstones.

Hornblende  
and felspathic  
rocks.

the granite, is a fine, tender, highly micaceous or gneissic sandstone, sometimes grey but commonly possessing a purplish grey or lilac tint, distributed in clouds or bands, and not unfrequently characterizing the whole mass of the rock. With these sandstones are found at some points considerable bands of hornblende and felspathic rocks, the former including a very coarse dark-green diorite, together with beds of hornblende and actinolite schist, while the latter are usually grey, white-weathering and quartzose, with small crystals of felspar. Rocks of this character are well-exposed along the road leading from Sullivan's Creek, on the St. John River, to Canterbury station, and especially at and about the eminence known as Dorrington Hill. Here also are the best exposures of the calcareous beds, which seem to form a well-marked member of the group, and which are traceable at intervals throughout its entire length. Where exposed on the railway south of Canterbury station they are of inconsiderable thickness and quite impure from admixture of sandy and micaceous material, but at a point about one and a half miles south of Dorrington Hill, they are much purer, and of sufficient extent to induce their removal for calcination. They may here be clearly seen to form a part of the micaceous series, alternating with dark-grey micaceous sandstones, which are sometimes chloritic and contain sheafs of hornblende, or with beds of true hornblende schist; all the strata being much disturbed and the dip irregular, though usually to the northwest 70—80°.

Limestones of  
Canterbury.

Conglomerates.

Another set of beds seen in the vicinity of Dorrington Hill, and forming an exception to the usually fine-grained texture of the Cambro-Silurian rocks, is that of a series of somewhat coarse conglomerates and grits, exposed in and along the valley of Four-mile Creek, a small stream skirting the above-named eminence on its northern side and thence flowing to its junction with Eel River. These conglomerates are intimately connected with the micaceous sandstones, containing beds and layers indistinguishable from the latter, and are themselves highly micaceous, but at the same time contain numerous well rounded pebbles of grey felspathic quartzite, from one to twelve inches in length, together with others which would seem to have been derived from beds of gneiss, diorite and mica-schist. They thus at first sight suggest the idea of their being a series newer than, and derived from the Cambro-Silurian, but of this we could obtain no confirmation from the study of their stratigraphical relations, while their alternation with, and apparent graduation into, the sandstones, seem rather to indicate that both are of contemporaneous origin, the highly micaceous character of both, with the nature of the pebbles referred to, either resulting from a common derivation from some unknown Pre-Cambrian source, or else being the effect of a common alteration, in connection with the grani-

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tic intrusion, of beds of coarse and fine material. Similar conglomerates and grits, with similar associations, may also be seen just west of Deadwater Brook, along the more northerly of the roads leading westwardly from Canterbury to Skiff Lake; where pebbles in the conglomerates, owing to their superior hardness, project in rough knobs over the weathered surface of the rock often as much as an inch or more. These beds are interstratified with grey and lilac micaceous sandstones, but both are irregular in dip, with sharp local curves and corrugations. They may also be seen, though less conspicuously, on the west side of the First Eel River Lake, south of Monument settlement, and on the St. John River north of Sullivan's Creek.

Another well-developed belt of rocks traversing the parish of Canterbury bears some resemblance to that last described in the fact that it is likewise composed of somewhat coarse material and has a distinctly crystalline aspect, but differs in being much more felspathic and gneissoid, with evidences of at least a partially igneous origin. At its eastern extremity this belt approaches and appears to become continuous with the rocks of Four-mile Brook, forming somewhat prominent hills overlooking the Canterbury and Eel River road near Grant's mill, and apparently forms an anticlinal, flanked on either side by dark colored argillites, which are more less chloritic; but further west the two belts diverge until along the line of the railway they are separated by a considerable interval, occupied chiefly by argillites. At each of these localities the bulk of the rock is a highly felspathic and schistose or gneissic grit, containing in addition to glassy particles of quartz, others of white or green felspar and often chlorite; but at Grant's mills the beds are further peculiar in holding light-grey felspathic seams, from one to two inches in breadth, which branch and bifurcate irregularly after the manner of injected veins. In the hills near the railway, (at the 70th mile post,) they are equally remarkable as exhibiting upon their weathered surfaces, in addition to fine wavy lines which are apparently of fluxion origin rather than the result of sedimentation, innumerable closely-aggregated nodules, or what appear to be such, which often possess a distinctly concentric structure, and are probably concretionary. Still further west, beds which conform both in character and position to these form the eminence known as Pokowogamis Ridge, and were finally seen crossing the road along the west side of Eel River Lake.

In addition to the features noted, the partially igneous origin of these rocks is, at each point of their occurrence, indicated by their association with well-marked amygdaloidal beds, of grey, green and purple colors, which are usually found flanking the felspathic and gneissoid beds. The re-appearance of rocks of this latter character,

with similar associations, still further north, in two or more belts traversing the southwestern portion of Carleton county and separated by belts of argillite, would seem to indicate that they represent the crests of so many folds over which these argillites were at one time spread, but which are now exposed by denudation. Another of these belts may be seen crossing the railway track at mile post 72, in the form of a light-grey, white-weathering quartz-porphyrity, and again about half way between mile posts 72 and 73. Here they consist chiefly of light greenish-grey felspathic grits, which are somewhat coarse in texture and contain imperfectly developed hornblende crystals and are often porphyritic or amygdaloidal, but they include also some beds of fine felspathic slate which are nearly vertical (N. 10 W. > 80°-90°). By far the most considerable, however, as well as the most remarkable belt of such rocks is one appearing along the line of railway two or three miles north of Benton, and forming the prominence of Oak Mountain, from which in a westerly direction it extends along the northern side of Eel River to Monument settlement in South Richmond, and in an easterly one to and beyond the St. John River at Woodstock. As seen on the eastern slope of Oak Mountain and along the railway track, where the belt of these rocks has a total breadth of about a mile-and-a-quarter, the bulk of the latter, as at the localities already described, is evidently sedimentary, showing distinct lines of deposition and having the aspect of an altered or gneissoid grit, as well as including some layers of slate, but here these appearances are in general much less marked and the evidences of alteration more extreme. Many of the beds are massive, without evident stratification, conspicuously porphyritic, and contain distinctly formed crystals of hornblende and sometimes of augite, together with chlorite and epidote. It seems, moreover, impossible to doubt that these peculiarities are intimately connected, either as accompaniments or as a consequence of their association with the great mass of presumably intrusive syenite with which on their southern side they are in contact, into which they seem to graduate and which accompanies them throughout their length. This graduation is the more remarkable as it is in singular contrast with what is seen along the lines of contact with the granite, where the transition is usually quite abrupt.

Benton and  
Oak Mountain.

Felspathic and  
augitic rocks.

Oak Mountain.

Hematites.

The bulk of the strata composing Oak Mountain are similar to those exposed in the railway sections at its base, including, besides felspathic grits and slates, beds of compact and amygdaloidal diorite and imperfect syenite. In addition, however, to these beds, there are also some, not elsewhere seen in connection with this formation, in the form of deep red and highly ferruginous slates, containing beds of red slaty hematite. These rocks, which occur on the northwest slope of the

mountain, unlike many possibly be that they described where they few, nothing determined Beyond the of the broo lar rock, co beds of wh overlapped the base of

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mountain, overlooking the valley of Pokomoonshine Brook, are not unlike many of the iron-bearing beds of the Silurian, and they may possibly be an outlier of that formation, but it seems more probable that they are Cambro-Silurian and the equivalents of the similar beds described by Mr. Ells and others in Gloucester county. The point where they occur being in a dense forest and the exposures therefore few, nothing definite either as to their thickness or relations could be determined. Their dip, where observed, was N. 20 W.  $> 80^\circ$ . Beyond these beds, but at a much lower level, there are, in the valley of the brook last referred to, ledges of very hard greenish-grey vesicular rock, containing dark-brown prismatic crystals of augite, as well as beds of white weathering felspathic quartzite; these being in turn overlapped by the ribbanded calcareous slates which here represent the base of the Silurian system.

Contact of  
systems.

West of Oak Mountain this belt of rock becomes less conspicuous, both it and the associated syenite sinking out of view beneath the low and artificially flooded area along the upper course of Eel River-Boulders, however, which are evidently derived from it, and consist chiefly of extremely coarse and highly crystalline amygdaloid, of bright-green, red and purple colors, and contain much chlorite and epidote, are thickly scattered over the country to the south, more particularly along the Dinnen road, where the latter traverses Pokowagamis settlement. Near Kirkland post-office in South Richmond bogamis beds are seen *in situ*, consisting in part of amygdaloidal diorites, but chiefly of a coarse agglomerate, in which both pebbles and paste are alike composed of chlorite, epidote and vesicular diorite. Here also their relations to the Silurian are well exhibited, they being directly overlaid by the ribbanded calcareous slates, while only a short distance to the westward are the coarse calcareous conglomerates of Bull Creek, through which fragments derived from these amygdaloids are abundantly distributed.

Pokowagamis  
Sett.

So. Richmond.

Contact of  
systems.

Eastward of Oak Mountain the relations of the two systems of rocks are equally clear. Their unconformable contact at O'Donnell's crossing near Debec, has already been described. Here the supposed Cambro-Silurian rocks consist of flinty felsites and of very hard white-weathering felspathic quartzites, together with beds of amygdaloid, both of which are similar to those of Pokomoonshine Brook, and are covered by a Silurian conglomerate containing fragments derived from these rocks; and further east similar felsites outcrop on the branch railway leading into Woodstock; but in approaching the last named town these are less clearly seen, while beds more like those of Oak Mountain again come prominently into view. Along the west bank of the St. John River they are exposed at intervals all the way from Bull's Creek,

Woodstock.

Meduxnakeag.

south of Woodstock, where they meet and pass into red and grey syenite, to within four miles of Victoria corner, north of the same place. Along portions of this shore, as at the mouth of the Meduxnakeag, are slates of a greenish or reddish color, which may be a continuation of the hematite beds of Oak Mountain, and there are also grey slates and sandstones, but the prevailing rock is a quartzose felspathic grit, generally containing hornblende or augite mingled with particles of green felspar. It is very obscurely stratified and at times markedly columnar, and often difficult to distinguish from a true syenite. These varying features are well exhibited in the railway cuttings south of the town, and again about and between the bridges which span the St. John River a short distance above it.

The rocks which have been described above as gneissoid, felspathic and syenitic grits, with the associated felsites and the similar rocks to be presently noticed on the eastern side of the St. John River, are those about which a doubt has been expressed whether they may not really be of Pre-Cambrian rather than Cambro-Silurian age. Their lithological characters, recalling those of certain parts of the Huronian system in St. John county, certainly give some countenance to this view, and it is one which derives some further confirmation from the observations of Mr. Ells on what is probably the eastward extension of these beds on the Miramichi and Nepisiquit, while their stratigraphical relations leave the matter in doubt; but considering their limited and irregular distribution, the impossibility of mapping them separately with accuracy, and especially the want of any positive evidence of their greater antiquity, it is deemed best, as has been stated, for the present at least, to include them as a part of the Cambro-Silurian system.

Argillites.

It only remains, in concluding the description of this system as seen on the west side of the St. John River, to add a few words relative to the less altered slates and sandstones which occupy the intervals between these crystalline belts, and which are believed to be the most recent Cambro-Silurian rocks. In their inferior portion, where they rest upon and alternate with the micaceous sandstones, they are themselves micaceous, as well as black, pyritous and sometimes graphitic, (including on the St. John River, above Sullivan's Creek, some highly calcareous beds, remarkable for the extent to which they are seamed with spar); but commonly they are of simple grey or dark-grey colors, often with a pale greenish tint from the presence of disseminated chlorite, and consisting of alternating beds of ordinary slate and hard fine sandstone or quartzite. The latter vary from one to four or five feet in thickness, and are usually more or less felspathic. With the exception mentioned they are rarely calcareous in any sensible degree but usually contain more or less pyrite and are often rusty weathering

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Many of the beds exhibit surfaces covered with ripple marks and other indications of their aqueous and shallow water origin, but the most diligent search has as yet failed to discover the existence of any organic remains. In attitude they are greatly disturbed, exhibiting numerous folds and slickensides, indicative of faulting, while veins of quartz and chlorite abound, and, less commonly, dykes or irregular masses of diorite and syenite. All these features may be well studied along the line of the St. John River between the mouth of Eel River and Woodstock, as well as on the main line of the New Brunswick railway and the Woodstock branch.

The extension of the northern belt of Cambro-Silurian rocks east of the St. John River will admit of more brief description, as the features which these present are similar for the most part to those already described, while they are at the same time less thoroughly exposed. Along the river from the succession, as far as seen, corresponds to that of the opposite side. The slates and quartzites form the greater portion of the shore in Middle and Upper Southampton and the lower part of Northampton, but are broken by irregular masses of syenite, while opposite Woodstock the hills are chiefly composed of felspathic, granitoid and gneissoid grits. These are followed, towards Newburgh, by green and red chloritic schists, which run parallel to the river with a high northwesterly dip, and are well exposed in the deep gorge at the mouth of Acker's creek. The more northerly beds of the system exposed in this section are seen in the cuttings along the railway track at and about the mouth of Deep Creek. They consist of heavy beds of greenish-grey dioritic sandstone, mingled with more schistose beds of green and purple colors, all of which contain much disseminated chlorite and are stained with iron and manganese. The dip varies from S. 20 W. at Deep Creek to N. 20 W. about a-quarter of a mile above. In this direction these beds are, at the mouth of the Little Pokiok, followed by the grey calcareous conglomerates of the Silurian.

Eastward of the river the country is to a large extent uncleared. Members of the lower crystalline division (gneiss, &c.) may, however, be seen at many points along the northern side of the granite, through the settlements of Middle Southampton, Maple Ridge and Norton-dale; the beds most frequently met with being dark colored slates, which are sometimes plumbaginous, and greenish schists containing chlorite. In the settlement west of Nigger Brook they include a workable bed of limestone, in character not unlike that of Dorrington Hill and Canterbury. It is noticeable that there are here but few beds of the purple or lilac micaceous sandstones so conspicuous in the last named parish; the rocks which approach the granite most nearly at Millville being the black plumbaginous slates, while just east, on Howland Ridge, still

Southampton  
and Northamp-  
ton.

Acker's Creek.

Contact of  
systems.

Limestone.



- Millville.** higher beds, consisting of dark-grey to black fissile and rusty argillites, seem to run against and to be cut off by a northward sweep of the granitic mass. Along the railway and roads north of Millville the rocks are also chiefly argillites, which are often quite chloritic, but with these are heavy beds of grey and dark-grey felspathic sandstones or grits, which are somewhat amygdaloidal. Beds of diorite and pale pink to red porphyritic felsite also occur. These rocks are evidently the same as those of Oak Mountain, Benton and Woodstock, and like the latter may be of Pre-Cambrian origin, though no distinct evidence of a difference of age could be detected. Other considerable areas of rocks to which similar remarks apply occur to the east of the railway, about the headwaters of the main Nacawicac and the Beceaguimic.
- Nacawicac.** Near the source of the first named stream, in Mapleton, three very prominent hills, known as the Spruce Peaks, but which actually form parts of a single ridge, constitute a marked feature in the landscape. They consist of grey felspathic rock, in part fine-grained and approaching felsite and in part granular, with white silicious blotches and veins of epidote. Six miles further east another prominent ridge, separating the North-east Branch of Nacawicac from the heads of the Keswick and Beceaguimic, consists of a hard crystalline felsite, varying from dark-grey to red in colour and which is porphyritic with small crystals of felspar. Similar rocks occur upon both branches of the Beceaguimic, and may possibly be intrusive. With these exceptions the rocks of this district are chiefly slates and sandstones, sometimes chloritic and sometimes felspathic, the bare white ledges of which are exposed for over a mile along the railway track south of Nacawicac station.
- Spruce Peaks.**
- Felsite.**
- We come now to consider the second band of Cambro-Silurian rocks, included in or resting upon the great granitic axis of York county.
- West of the St. John River the rocks of this system included in the granitic area are few and unimportant—the only points known being a small area at the Meductic, others at the head of Grand (Schoodic) Lake, and, as reported, on the Palfrey stream, a few miles below Skiff Lake—but on the eastern side they are more considerable, forming a belt traversing portions of the parishes of Queensbury and Bright, and gradually widening from the St. John River at the Coac to the valley of the Keswick. They are here chiefly interesting from their relations to the granite and the comparatively clear view which they exhibit of the Cambro-Silurian succession. The former are well seen at the Coac, where purplish-grey or lilac micaceous sandstones, similar in every respect to those of Canterbury, not only show their contact with the granite, but are filled with a network of quartzose and granitic veins.
- Queensbury.**
- Contact with granite.**
- Caverhill.** Eastward of this, in Upper and Lower Caverhill, similar sandstones, which are often gneissic, are associated with black pyritous and rusty-

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weathering mica slates and micaceous quartzites, traversed with numerous white quartz veins, and have a general southerly dip (S. 40 E.  $< 60^\circ$ ); while in Springfield similar beds, again rest upon granite and dip northerly (N. 70 E.  $< 80^\circ$ ). The synclinal structure thus indicated is, however, better seen along the roads leading south from Haynesville to Blowdown and Zealand. In Haynesville proper the micaceous and gneissic strata, which are often mottled or filled with dull black specks, probably representing incipient staurolite crystals, dip, as in Caverhill, southerly from the granite of the Nacawicne; but on the other side of the belt, on approaching the granites of Zealand, similar strata are again met with, with a somewhat irregular but generally northward dip, the intervening area being occupied by bluish grey slates and sandstones, exhibiting a similar arrangement. These latter rocks, which tend to break up into angular blocks, are in this respect as also in colour and texture indistinguishable from those of the Woodstock branch railway, as well as from those of the southern Cambro-Silurian belt to be next described in Prince William and Bright. Both their position and their graduation into the micaceous strata below indicate that they are portions of a single formation, of which the lower members have been altered in connection with their proximity to the granite upon which they rest. It is noticeable that among these strata there are no representatives of the felspathic gneisses, schists, felsites or amygdaloids which are so conspicuous in the northern belt, a fact which gives some further support to the view that these latter are Pre-Cambrian rocks protruding through the Cambro-Silurian slates.

The southern Cambro-Silurian belt, referred to above, is a very extensive one, embracing, as it does, most if not all of the Pro-Carboniferous rocks between the granite and the Coal basin. Owing to the irregular course of the granite on the one hand and the still more irregular distribution of the overlapping Carboniferous strata upon the other, the belt is of somewhat variable breadth and outline, but may be described as extending continuously from the Maine frontier, south of Vanceboro, through the parish of Prince William to the St. John River; and eastward of the latter, through portions of Queensbury and Bright, to the valley of the Keswick; beyond which it is again seen in the valleys of the Nashwank and Miramichi, though outside of the limits to which this report relates. Owing to the hardness of the rocks underlying this district and their deficiency in lime, the soils covering them are usually neither deep nor rich, while large portions, especially near the granite, are rendered unfit for cultivation by the great number of boulders or loose blocks with which they are covered, or by the occurrence of heavy deposits of clay. When, however, these are absent, the soil is capable of yielding a fair return, and within the district are situated a large number of flourishing settlements.

Springfield.

Synclinal.

Southern  
Cambro-Silurian belt.

Distribution.

Surface  
features.

Lithological features.

Comparison of northern and southern belts.

Comparison with rocks of other counties.

The rocks of this southern belt consist almost entirely of slates and hard sandstones or quartzites, of a grey colour, and lack almost altogether the crystalline character so conspicuously seen in portions of the belts already described. Here also, as in the middle belt last noticed, there is an entire absence of the great bands of felspathic, hornblendic and felsitic rocks which form such marked features in the geology of Canterbury, Woodstock and Millville. Yet, leaving out of view these rocks of doubtful origin, and many of which may be igneous or intrusive, there can be no question of the essential identity of the remainder with those of the southern belt under discussion. For although, in part owing to concealment by the drift, their resemblances are somewhat obscured, most of the characteristic features of the one are, at different points, reproduced in the other. Thus the peculiar pink or lilac tint and micaceous or gneissic aspect so common in the rocks of the northern belt, while seen only rarely west of the St. John River, (as near Magaguadavic, Blaney Ridge and the Antimony mines of Prince William), are very clearly marked on the eastern side of the river in the section just south of the granite at Bear Island, about Scotch Lake, and especially in the valley of the Keswick north of Zealand; in each of which localities the first named beds are directly followed by and graduate into the ordinary grey slates and quartzites, while in Zealand both sets of beds double around the granite which terminates at this point and become continuous with the similar beds of the central or Haynesville belt. Again, it is unusual to find in the southern belt anything approaching true gneisses or mica schists, the alteration not extending beyond a change of colour and a partial development of mica in the sandstones; but in the extension of these rocks to the Nashwaak River, there is, just south of the granite at the Napadaugon, a series of schists filled with tolerably well developed crystals of staurolite, and this in turn is followed by a wide belt of dark-grey to black highly micaceous slates which are literally studded with cubical crystals of pyrite. So, as a rule, the ordinary slates and sandstones of the southern belt are less felspathic and chloritic than those seen on the river south of Woodstock; but on the Nashwaak, north of Stanley Bridge, slates and sandstones which are probably of this series are highly chloritic as well as micaceous, and recall in the former respect, as they do in their greenish and purplish colours, the slates of the Meduxnakeag and Acker's Brook. No calcareous strata have yet been observed in any portion of this southern belt.

In closing the description of the Cambro-Silurian areas of York and Carleton, it is instructive to notice the close parallelism here exhibited with the rocks referred to the same horizon in northern Charlotte and southern Queen's. (See Report of Progress 1870-71). This parallel-

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ism may be of the same nature or may be entirely similar instances, with the abundant

These rocks extend over a large area which they intersect in various directions. In the described rocks and dolerite

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Another connection described their crystals originated Caverhill

ism may be traced in almost every particular, whether of colour, texture or mineral composition, but is especially noticeable in the apparently similar influence of the causes originating the granite in both instances, determining the same highly micaceous character in each, with the development of the same crystalline minerals, as both are abundantly invaded by granitic and syenitic intrusions.

#### GRANITES, SYENITES AND INTRUDED ROCKS.

These rocks require some further notice if only on account of the extent of the areas which they occupy and the important influence which they are believed to have exerted upon the associated formations. In addition to the granites and syenites the rocks to be described in this place include felsites and felspar porphyries, diorites and dolerite or diabase.

*Granite.*—The extent to which this rock is represented in central and western New Brunswick constitutes one of the most marked features in the geology of the latter, and, with somewhat varying outlines, has been represented in all the published geological maps of the province. The limits which have been assigned in the preceding pages as well as upon the accompanying map have been very carefully determined, and are probably as nearly accurate as the facts of the case will permit, the exact outlines being often difficult to recognize, first from the extent to which the granite itself penetrates the surrounding formations, and secondly from the great accumulations of boulders and other drift material which cover its surface and obscure the lines of contact. The great number and large size of these boulders is quite remarkable, and it would probably be no exaggeration to say that over large areas, as around McAdam junction, they are so thickly strewed as completely to conceal the subjacent rock and to determine a region nearly or quite destitute of soil. Where, however, the loose material is less abundant and the soil not farther impoverished by forest fires, it is regarded by many with much favor, as being especially adapted for the growth of cereals and for grazing. Many interesting facts relating to the surface geology of the region will be found in the report of Mr. Chalmers.

Another circumstance tending to make difficult the correct delineation of the granitic areas is the very irregular distribution over or in connection with them, of the gneissic and micaceous strata already described as Cambro-Silurian, and which are supposed to have derived their crystalline character from the influence of the same causes which originated the granite. The larger of these areas, such as that of Caverhill and Haynesville, have been already referred to; but a

Effects of  
erosion.

number of much smaller areas occur, some of which do not exceed a few rods or even feet in extent. It seems evident that the whole or the greater part of the granite mass has been at one time covered with these rocks, which have since been irregularly removed by erosion; and it is worth noticing in this connection that the belts of crystalline Cambro-Silurian rocks already described form generally a higher and more broken country than that of the adjacent granite, and often rise abruptly from the latter.

Enclosed  
masses.

The granites in question are usually of coarse texture, containing quartz, felspar and mica in nearly equal proportions, with the felspar, which is commonly orthoclase, often in crystals of large size (sometimes three inches by two) which project conspicuously upon weathered surfaces. The colour is usually grey, but sometimes nearly white, or on the other hand, as on the St. John River near the Pokioik, of a rich red, making a rock well adapted for architectural and ornamental purposes. A more noticeable peculiarity, however, is the extent to which the rock is filled with what are evidently imbedded fragments of other rock, sometimes of a dark-green colour and containing much hornblende, but more frequently having the character of a grey or purplish-grey micaceous sandstone or mica schist. So abundant indeed are these enclosed masses in some places as to give to the rock, at a short distance, the appearance of a coarse conglomerate. Their origin is beyond question, not only from their evident identity with the schistose and micaceous rocks which border and in part cover the granitic area, (retaining the colour, texture and foliation of the latter even at great distances from the nearest resembling beds), but again from what is seen at many points along their lines of contact. Among the best places wherein the latter may be observed may be mentioned the mouth of the Shegomoc River and the hills about the head of North Lake. At each of these localities, but especially at the former, not only is the granite seen extending in the form of veins, in all directions into the overlying rocks, but within the granite itself occur large numbers of what are evidently detached masses of the latter in cubical and other blocks. In looking at these exposures one can hardly resist the impression that the granite has been in some way injected into an overlying and partially shattered schistose rock, and that the alteration of the latter has been the effect of such intrusion. That such appearances are capable of other explanation is of course admitted, but that the granite enclosing the masses referred to is not of the nature of simple veins and possibly of much later origin than the penetrated rock, is indicated by its entire identity with the main mass of the granite, while the true segregated veins with which both are intersected are readily recognizable by their much coarser charac-

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ter. It may be again added that in all the points referred to the granites of York show the closest possible resemblance to those of Charlotte county, as seen about the towns of St. Stephen, Milltown and Baring. (See Report of 1871).

In addition to the main belts of granite, limited isolated areas of such rock occur at various points along their borders, as east of McAdam, between the Shegomoc and Sullivan's Creek and again in the settlement of Zealand, their position and limits being indicated upon the geological map. From the number and relations of these areas it may fairly be inferred that at some depth beneath the surface they are continuous with each other, and the apparent contrasts which the schistose rocks exhibit, both in the amount of their alteration and in the distance from granite outcrops at which they are found, are probably connected with the same fact. On the other hand the singular abruptness with which wide belts of granite terminate without apparent reference to the strike of the overlying sediments, as illustrated in the last of the localities above named, is equally noticeable, and may be regarded as a further indication of their probably intrusive origin.

*Syenite.*—This rock, although much less abundant than the granite, is of very frequent occurrence in the region under consideration, and covers some large areas. Of these the most noticeable, both for its extent and relations to the surrounding rocks, is that traversing the southern part of Carleton county, from Eel River about Benton to the St. John River at Bull Creek below Woodstock, having a length of nine and a-half and an average breadth of about one and a-quarter miles; while a second and smaller one but of which the exact limits could not be ascertained, occurs on the eastern side of the river along the course of Gibson's millstream. While in general a true syenite or hornblende granite, of grey or reddish colour and coarsely crystalline texture, the rock sometimes contains, especially about Benton, a good deal of pale green epidote in crystalline grains, and sometimes chloride, while it is not unfrequently associated with or penetrated by dykes of dark-green diorite, a circumstance nowhere noticed in connection with the granite region. A more interesting feature, as contrasted with the latter, is the very gradual passage exhibited by these syenitic rocks into the felspathic, gritty and amygdaloidal beds with which they are associated, and which renders it well nigh impossible to draw a line of division between them, while in the case of the granites the transition is in almost every instance abrupt. It would almost seem as though the syenites, in the instances referred to, were only more intensely altered conditions of the associated rocks; but that they are in some instances at least intrusive is shown by the irregular way in which they are often found cutting the slaty rocks, or are enclosed in irregular masses

Granite  
outliers.

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between the partially opened beds. It is noticeable further, as bearing upon the time of these intrusions, that large syenitic dykes or veins are found penetrating even Silurian strata, (as well exhibited on the shore of the St. John River a few miles above Hartland), while true granites have not been observed apart from connection with the supposed Cambro-Silurian system. At Bull's Creek, south of Woodstock, the syenites and accompanying beds contain small veins and scattered grains of copper pyrites.

*Felsite.*—The position of the more considerable areas of this rock have been referred to in previous pages, where also their features and probable origin have been considered. In addition to the true crystalline felsites and quartz-porphyrics which occur in connection with the Cambro-Silurian system, felsitic rocks of less crystalline character and which pass into claystones, but which are still porphyritic, occur in connection with the Lower Carboniferous rocks at various points. Some of these, as about Harvey station and Cranberry Lake in York county, have been described in former reports, and similar beds occur about the sources of the Northeast and Southeast Branches of the Becaguimic River in Carleton. They are of red, purple and lilac colours, and both in character and position resemble those met with at the summit of the same formation in Queen's county. Veins of pure red crystalline orthoclase are also found, as at the Pokiok, intersecting the red granites.

*Diorite.*—Dykes of this rock are met with everywhere over the region examined, (except in the granitic areas), and in connection with all the Pre-Carboniferous rocks. It is especially abundant and forms large masses, which are partly interstratified, in connection with the Cambro-Silurian crystalline belt of Canterbury. It varies greatly in texture and, as at the localities last mentioned, is sometimes extremely coarse, with large and prominent crystals of hornblende, while the associated beds are also highly crystalline; but elsewhere it is generally fine and even grained, and its presence has exerted no perceptible influence, except perhaps as regards attitude, upon the beds in which it occurs. It is commonly pyritous and rusty-weathering.

*Dolerite, Basalt, Anamesite and Diabase.*—Rocks belonging to one or other of these species are common in the rocks of the Lower Carboniferous formation, especially along the horizon between the latter and the Millstone-grit. They are dark, heavy and compact rocks, usually fine-grained and breaking either with a broad conchoidal fracture or into sharp angular blocks, and occur both as dykes, beds and dome-like masses, exhibiting at times a distinctly columnar structure; but coarser varieties are also found, some of which are abundantly amyg-

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daloidal. In the latter the minerals chlorite, delessite and red heulandite are not unfrequently met with, as well as pseudomorphs of quartz and calcite.

#### ECONOMIC MINERALS.

The following are rocks or minerals which are or may become of economic importance in the district to which this report relates.

*Iron.*—In addition to the well-known beds of this mineral which traverse the region north of Woodstock and which have been fully described in previous reports, reference has been made in preceding pages to the occurrence of somewhat similar deposits on the northwest side of Oak Mountain near Benton. They occur in the middle of woods and are but imperfectly exposed, but seem to include beds of some thickness following the general trend of the Cambro-Silurian rocks with which they are found.

*Antimony.*—The occurrence of this metal at Prince William has been noticed in previous reports and full descriptions have been given of its distribution, mode of occurrence and associations. The efforts for its removal during the last few years, although involving considerable outlay, have been of an indeterminate and interrupted character, while the low price of the metal in the market and litigation arising from rival claims have still further tended to check vigorous and systematic working. At the time of our visit (October 1883) about eighty men were employed at the Brunswick mines, the only one then in operation, at wages varying from \$1.30 to \$1.50 per day, but not long after this the greater number of these were discharged and the work suspended. During the five months from May to October of the last year about twenty-nine tons of ore were sent off, chiefly to Medford, Mass., where the metal is largely employed in the manufacture of all kinds of rubber goods. The original capital stock of this company was \$100,000 which was subsequently increased to \$500,000, while the value of the plant, including a compressor, steel boiler, hoisting engine, steam pumps, &c., is about \$10,000. The freight from the mines to Prince William station on the New Brunswick railway, sixteen miles, is \$3 per ton, to Harvey station \$2, or to Medford, Mass., \$6.

The smelting and reduction of the ore, together with the manufacture of Babbit-metal, at one time carried on at these mines, has been for some time discontinued, and the somewhat expensive works erected for that purpose have been abandoned. It is said that something like \$400,000 have been expended by the various companies in this neighbourhood since operations first commenced.

To the facts given in previous reports relating to the geology of the mines, it may be here added that the rock recently removed from the



shafts of the Brunswick company is the peculiar dark lilac-grey and micaceous sandstone referred to in preceding pages as generally exhibited by the Cambro-Silurian system where the latter approaches the granite, and may indicate that the latter will be found at no great depth. The nearest exposures of this rock at the surface are near the school-house and corner in the Pokiok settlement, about three miles northwest from the mine, the intervening tract showing only the micaceous sandstones and granitoid dykes, in the former of which antimony has been found at a number of points.

As tending still further to show the wide distribution of this metal within the region examined, it may be mentioned that small pieces of antimony were found by Mr. Broad on the northern side of the granite, in a rock-cutting along the road from Canterbury station to the St. John River, about three miles east of the former.

*Copper.*—Small quantities of the sulphide of this metal, in the form of copper pyrites and sometimes associated with galenite or lead sulphide, have been observed at several points over the region examined, but chiefly in connection with the intrusive rocks of the parish of Woodstock. At Bull's Creek, a few miles below the latter town, the syenites, which here intersect the Cambro-Silurian slates and sandstones, are so far charged with this mineral as to have led, some years ago, to the opening of a mine at this point, but although considerable quantities of ore were removed was not found to be sufficiently abundant to make further operations advisable.

*Gold.*—No actual deposits of this precious metal have been met with by us, though special attention was given to its possible occurrence. Some facts, however, may be stated which seem to favor the belief that a part at least of the region examined will yet prove to be auriferous. The most important of these is the close resemblance, both in character and probable age, which may be noticed between the dark slate-quartzite series of Woodstock and Prince William on the one hand and the gold-bearing Atlantic coast-belt of Nova Scotia on the other. In each case the bulk of the formations consists of thick-bedded argillites and quartzites, usually of a dark color, containing little or no lime but often ferruginous, abounding with quartz veins and containing metallic sulphides, such as those of lead, copper and antimony. In each case they are highly disturbed, forming a series of anticlinal and synclinal folds. In each they are associated with numerous masses of intrusive or highly metamorphosed indigenous rock, such as granite, syenite and diorite, and in proximity to these crystalline masses in each case they become themselves more or less highly crystalline, passing into gneisses, garnetiferous and staurolitic mica-schists, &c. Finally, though in both instances nearly destitute of

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fossils, the weight of evidence is in favor of their Cambrian or Cambro-Silurian age.

To these general considerations it may be added that if we include with the Cambro-Silurian rocks of York the resembling strata of northern Charlotte county, it is in connection with these rocks, and for the most part with these only, that any actual and well authenticated discoveries of this metal have been made. Some of these, as regards the region about St. Stephen and the St. Croix River, have been referred to in previous reports. On the other hand numerous finds of gold have been reported from different localities in connection with the great slate and quartzite bands on either side of the granite axis in York. The greater part of these have been upon the eastern side of the St. John river and especially upon its tributaries the Nashwaak and Mniac, in regions which have been as yet only partially surveyed, but there is little doubt that the rocks in which they were found are of the same age and character as those now referred to. So far the gold obtained has been derived only from washings and in small quantities, but careful and systematic search will probably have the effect of disclosing the beds from which it has been derived, if not also a more abundant supply. Specimens of ferruginous quartz, derived from veins in this series have been submitted to analysis, but so far with only negative results.

*Tin.*—This is another metal of which the existence in this part of the province is to be regarded as a possible or probable, rather than as a demonstrated fact. It is true that the occurrence of tin in connection with the granites of the Pokiok River was long ago reported by Dr. Gesner, and a specimen obtained by him is now in the collection of the Gesner Museum in St. John; but the precise locality from which this was obtained is not known, and no similar discoveries have since been made. The fact, however, that tinstone has been found near Waterville in the State of Maine, in connection with gneisses and mica-schists which appear to be identical with the Cambro-Silurian rocks of York county, lends much probability to the fact of its occurrence here as well.

*Limestones.*—Two horizons of calcareous beds have been referred to in the course of this report; the one in connection with the highly crystalline schists and gneisses of Canterbury, the other with the Silurian calcareous slates of Carleton county. The rocks of the former, partaking of the character of the associated beds, are also highly crystalline and in part a true marble, but in general are too impure from disseminated micaceous and sandy material to be of much value either for ornamental purposes or as a source of lime. The purest as well as the thickest beds known are found a mile or so south of Dorrington

Hill, on the road from Eel River to Canterbury, and several quarries have been here opened, but the lime manufactured from them cannot compete, either as regards price or quality, with that derived from the limestone quarries near St. John. The Silurian limestones are more abundant and more serviceable, but the more important beds, those of the Beccagumic region, are beyond the area to which the present report relates. On the western side of the St. John River, the representatives of these calcareous beds have been referred to as exposed at Ivy's Corner, south-west of Debec Junction, and here also some lime was formerly burnt, but the unfavorable position of the deposits, together with the difficulty and cost of drainage, have led to their abandonment.

*Granite, Syenite, &c.*—Over the very extensive area occupied by granitic rocks in York county, there are comparatively few points where these are of such a character or are so situated as to be available for economic purposes. Along the main line of the New Brunswick railway, between McAdam and Canterbury, though boulders of this rock, often of enormous size, are thickly scattered over the entire country, few actual ledges are anywhere visible, and the same remark applies to much of the region about the Chepedueck lakes. On the St. John River, however, there are extensive outcrops directly along the waters' edge, and from them any desired quantity might readily and cheaply be removed. Much of the rock is coarsely crystalline and porphyritic, and of the ordinary grey colour, but other portions are finer, more uniform, and of various shades of pink or red. The handsomest varieties were seen just at and below the mouth of the Pokiok, where a rich red granite occurs, quite equal in depth and brilliancy of colouring to any of those now derived from the quarries at St. George, in Charlotte county. The rock about the Nacawicac, south of Millville, though of the ordinary grey variety, seems to be of excellent quality, and is highly valued for local use. From its proximity to the railway it is favorably situated for removal.

The chief band of syenites, and the only one which seems capable of affording material for economic use, within the region examined, is that extending between Eel River at Benton and the St. John River below Woodstock. Much of this rock is highly crystalline, of a bright-red colour and uniform texture, and would answer for many of the purposes to which granite is applied, though little is yet known of its relative durability. Near Benton the rock is peculiar in containing a nearly uniform admixture of a pale grass-green epidote, presenting a handsome appearance when polished.

*Felsite, Quartz-porphyr.*—Several belts of this character have been described as crossing the line of the New Brunswick railway,

north of Canterbury, and again, on the eastern side of the river, north of Millville. Some of these would doubtless make, if polished, handsome rocks. The finest as well as the largest beds seen by us, however, are those east and northeast of the last named place, about the headwaters of the branches of the Beccaguimic. Here the rock is fine, compact and even-grained, of pale pink to flesh-red colour, and often conspicuously porphyritic. It is, however, unfavorably situated for removal.

